

CHAPTER 2

DOD VISION FOR M&S

A. DOD M&S VISION

1. In 1991, the Deputy Secretary of Defense assigned overall management responsibility of all DoD M&S to the USD(A), now the USD for Acquisition and Technology. To assist the USD(A) in managing DoD M&S, the USD(A) established the DoD EXCIMS and granted it oversight and management authority. The USD(A) tasked the EXCIMS to develop a vision for DoD M&S to help focus the DoD's M&S community on core functions. The EXCIMS focused on applying M&S in ways that would enhance overall U.S. military capability.

2. These ideas were incorporated by the EXCIMS into the DoD M&S vision:

a. Defense modeling and simulation will provide readily available, operationally valid environments for use by the DoD Components:

(1) To train jointly, develop doctrine and tactics, formulate operational plans, and assess warfighting situations.

(2) To support technology assessment, system upgrade, prototype and full-scale development, and force structuring.

b. Furthermore, common use of these environments will promote a closer interaction between the operations and acquisition communities in carrying out their respective responsibilities. To allow maximum utility and flexibility, these modeling and simulation environments will be constructed from affordable, reusable components interoperating through an open systems architecture.

B. DISCUSSION OF THE VISION

1. The DoD M&S Vision encompasses models and simulations ranging from high-fidelity engineering models to highly-aggregated, campaign-level simulations involving joint forces. It includes all types of models and simulations and embraces the full range of M&S interaction between the scope of the simulation, sponsoring component objectives and functional area requirements (e.g., education, training and military operations; analysis; research and development; test and evaluation; production and logistics). Figure 2-1 illustrates the range of M&S embraced by the DoD M&S Vision. It notes that there are many other perspectives of M&S, including the level of resolution, degree of human participation, degree of physical realism, time-management

method, time-step resolution, degree of distribution, and computational complexity.

2. Advanced M&S may integrate a mix of computer simulations, actual warfighting systems, and weapon system simulators. The entities may be distributed geographically and connected through a high-speed network. Warriors at all levels will use M&S to challenge their military skills at tactical, operational, or strategic levels of war through the use of synthetic environments representing every potential opponent in any region of the world, with realistic interactions. Acquisition personnel may use the same synthetic environments for research, development, and test and evaluation activities. M&S will increasingly be used to improve efficiency and effectiveness in engineering development and system design, manufacturing, and logistical support functions. Acquisition personnel will also use synthetic environments to support the acquisition decisionmaking process. Such synthetic environments¹ will be accessible to all appropriate functional users.

Additional M&S Dimensions

- Level of Resolution
- Degree of Human Participation
- Degree of Physical Realism
- Time Management Method
- Time Step Resolution
- Degree of Distribution
- Computational Complexity

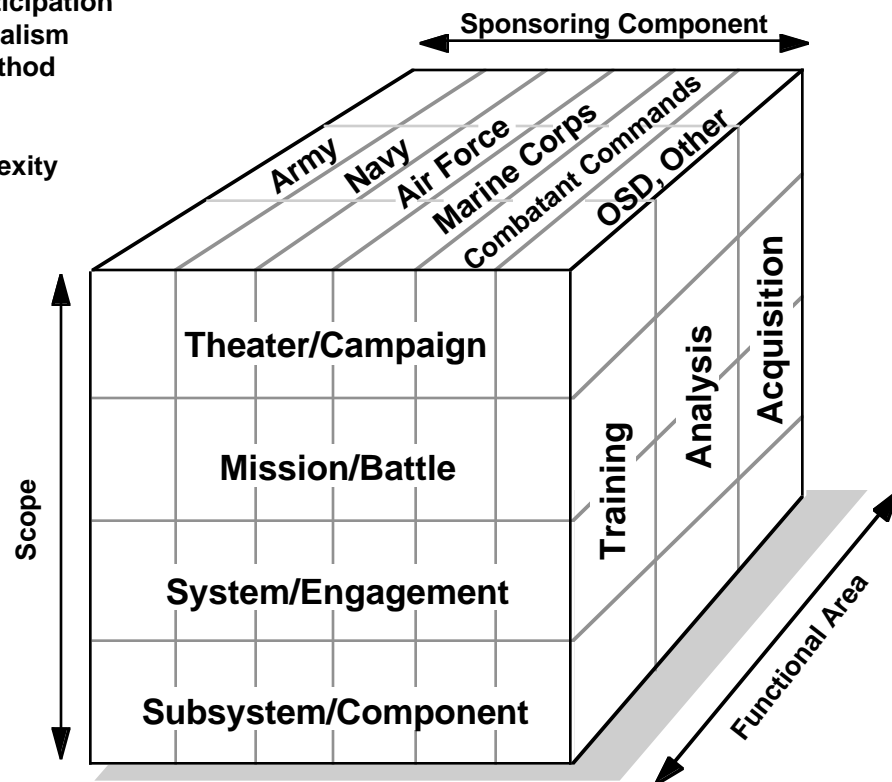


Figure 2-1. Range of M&S Embraced by the DoD M&S Vision

¹ See definition 53.

C. FUTURE M&S SUPPORT TO THE FOUR PILLARS OF MILITARY CAPABILITY

M&S can substantially improve capabilities and decisionmaking in each of the four pillars of military capability: 1.) readiness, 2.) modernization, 3.) force structure, and 4.) sustainability. There are very challenging aspects to these descriptions, and achieving full capabilities will require long-term, systematic, coordinated efforts across the Department of Defense.

1. Readiness. M&S will enhance readiness by allowing UCCs and Services to train forces, develop doctrine and tactics, assess performance of units, support planning, execution, and analysis of operations and exercises, evaluate operational plans, conduct "what if" analyses on those plans, rehearse missions, and support analysis of the political, military, and economic dimensions of security for policy development.

a. M&S will allow training to be joint, to involve Active and Reserve forces, to span multiple echelons, and to include computer-generated simulations of large-scale forces in a synthetic environment. Computer-generated forces (friendly, neutral, and hostile) will replace some human participants, allowing the representation of realistic large-scale forces in the synthetic environment controlled by a small number of human commanders. The synthetic environments will be able to bridge large geographic regions worldwide and involve the entire joint force, from senior commanders down to individual soldiers. Trainees will interact with the synthetic environment through their actual "go-to-war" command, control, communications, computers, and intelligence (C⁴I) equipment and weapon systems.

b. M&S will provide training for the complete spectrum of military operations for all regions of the world and affected regions of space. Exercise and training feedback will be available in near-real-time, with after-action reporting systems and exercise reconstruction systems providing a robust analysis capability.

c. M&S will be used to evaluate readiness, assess warfighting situations, and assist in the development and evaluation of operational plans, doctrines, and tactics. M&S will support planners by providing insights into the effectiveness of theater-level campaign plans, operational-level battle plans, and tactical-level mission plans. Decisionmakers will be able to simulate and evaluate the consequences of alternative courses of action during deliberate and crisis action planning. Automated scenario generation and database construction tools, along with easily accessible M&S resource repositories, will enable models and simulations to be set up on short notice.

d. M&S will allow warfighters and military planners to rehearse missions by immersing the warfighters in a synthetic environment that accurately simulates the anticipated terrain, environmental conditions, and threat. This capability will increase the probability of mission success by fostering familiarity and proficiency with the mission plan and it can provide feedback to improve the plan.

e. M&S will provide exploratory and developmental models to support analysis of the political, military, and economic dimensions of national and international security, including the interactions between these dimensions. As they mature, these models will support formulation of national security policy.

2. Modernization. Models and simulations will reduce the time, resources, and risks of the acquisition process and will increase the quality of the systems being acquired. Representations of proposed systems (virtual prototypes) will be embedded in realistic synthetic environments. Such virtual prototypes will support the many phases of the acquisition process from requirements determination and initial concept exploration to the manufacturing and testing of new systems. (See Figure 2-2.)

a. Early operational assessments of new systems and systems upgrades proposed by the government or industry will be examined, within synthetic environments, for their operational and logistical impact prior to milestone I or milestone IV as appropriate. System requirements will be refined. Cost and operational effectiveness assessments will be more accurate and will improve resource allocation decisions. Decisionmakers will be able to compare alternative modernization strategies, using the synthetic environment, to determine which set of new system acquisitions yields the greatest overall mission effectiveness. During system development, continuing evaluations in these synthetic environments will improve engineering trade-off analyses and ensure that the final product optimally satisfies DoD needs.

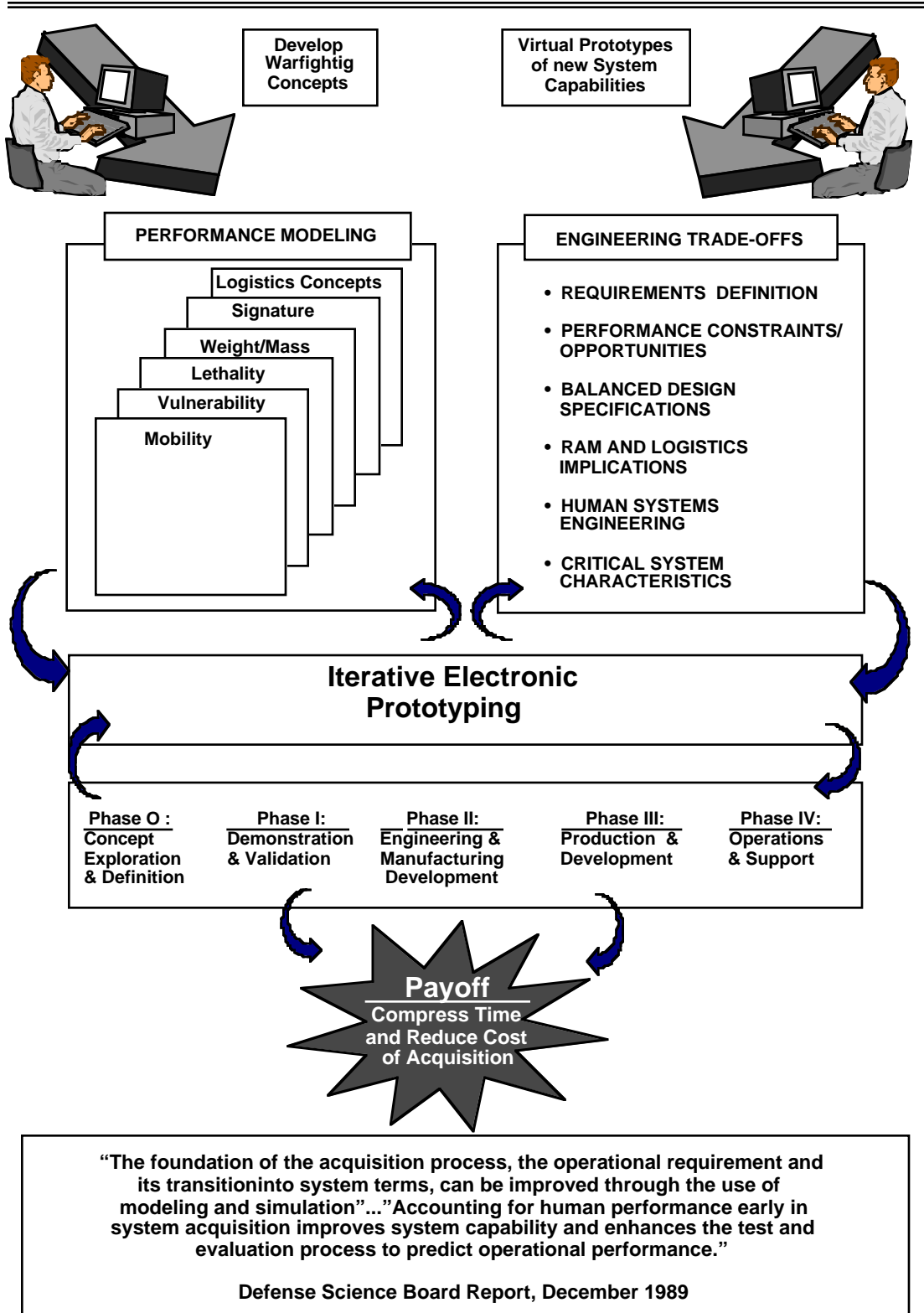


Figure 2-2. Vision of M&S Support to the Acquisition Process

b. M&S will allow testers to create realistic developmental and operational test scenarios and will improve the test and evaluation planning process. Synthetic environments will allow "dry runs" of planned tests to verify that test conditions can be met with sufficient realism and cost-effectiveness. M&S can be used to focus test objectives resulting in reduced field test assets, resources, test iterations, and test duration. Use of simulation will also allow evaluation of tests otherwise infusible due to limited test resources, environmental restrictions, and/or safety constraints. They will also provide "synthetic" data to exercise the analysis and reporting systems. Virtual prototypes will allow operational testers to conduct early operational assessments in multiple threat environments. Synthetic environments will allow evaluation in environments not reasonably achievable in live testing due to safety or resource limitations. M&S will extend the evaluation of field test results by extrapolating to conditions beyond the scope of the field tests and by exploring any identified questionable areas as well as improve the leveraging of data between developmental and operational tester. Weapon systems must be tested against opposing forces that accurately represent the capabilities and characteristics of potential adversary nations to include tactics, doctrine, force mix, and force strength.

c. M&S will enhance information-sharing among designers, manufacturers, logisticians, testers, and users. Virtual representations of the manufacturing process will be used to examine how the manufacturing process must adapt as weapon systems prototypes are changed. Increased dialogue among these groups and the users of the system will promote a closer interaction between the operations and acquisition communities, making both more effective.

3. Force Structure. M&S will give DoD leadership a powerful arsenal of tools to analyze alternative DoD force structures. Using synthetic environments, the effectiveness of different force compositions will be examined in a wide variety of potential mission scenarios (including operations other than war (OOTW)) against various potential adversaries and challenges across the globe and affected regions of space. M&S tools will support such decisions as the number of squadrons to equip with a particular type of aircraft, or be used to provide insights to such fundamental issues as the optimum roles, missions, size, and composition of each Service.

4. Sustainability. High-fidelity models of logistics will be integrated with combat models to allow for the analysis of combat sustainability; to study the effects of organization size, basing, and doctrine on the logistics infrastructure; and to determine the implications of alternative materiel management, maintenance, and

resourcing policies. System logistics and maintenance demands will be assessed to provide a realistic view of system life-cycle support requirements and costs.

D. ACTIVITY MODEL FOR TRANSFORMING THE VISION INTO REALITY

The six activities necessary to realize the DoD M&S Vision are identified in Figure 2-3, with their related sub-activities noted. This node-tree model provides the EXCIMS and Components with a useful management tool for stating objectives, choosing metrics, and making organizational decisions.

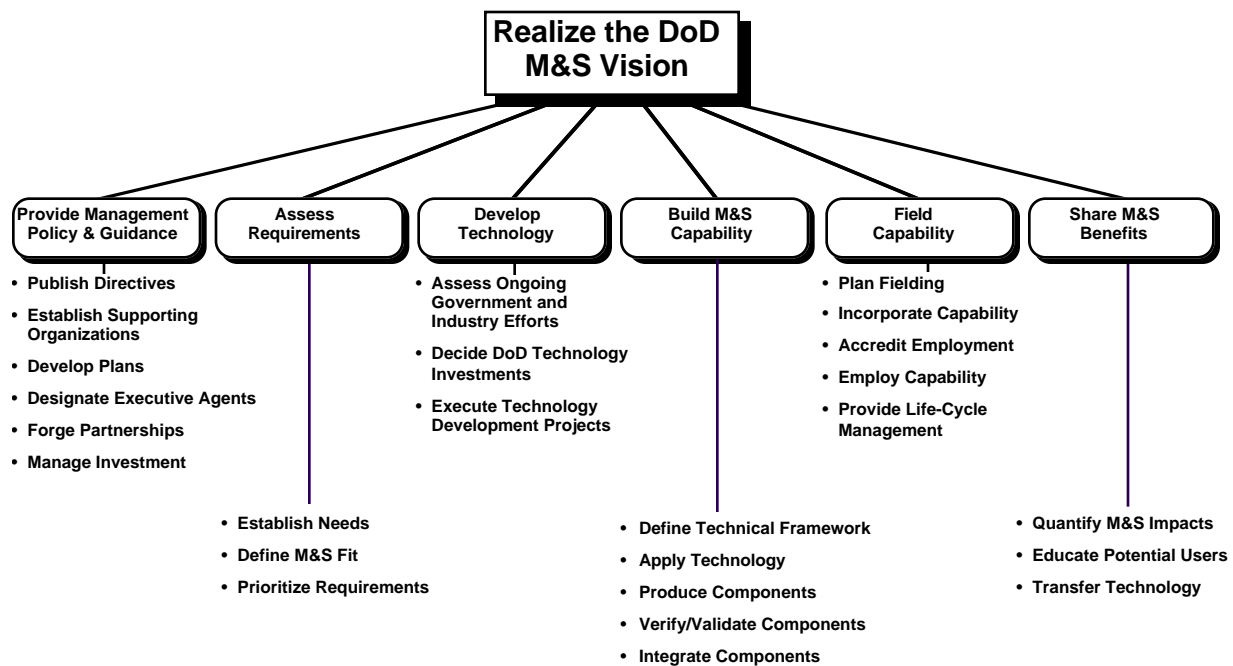


Figure 2-3. DoD M&S Activity Model

1. Provide Management, Policy & Guidance. Each DoD Component publishes appropriate directives, establishes organizations to support its M&S activities, and develops plans and budgets to satisfy the M&S needs of its Active and Reserve components as well as those of the Unified Combatant Commands and other DoD Components. USD(A&T) may assign responsibility for development and maintenance of a specific common or general-use M&S capability to a DoD Component by formally designating the Component as an Executive Agent. The DoD Components may also further their M&S goals by organizing partnerships within their own organizations or with other DoD Components to address common interests. Each Component must make prudent investments to achieve DoD's M&S objectives.

2. Assess M&S Requirements. The needs of all DoD users must be identified and an assessment must be made to determine the

potential and cost-effectiveness of M&S to satisfy the needs. The resulting M&S requirements must be prioritized for use in program planning, budgeting, and execution.

3. Develop Technology. It is necessary to continually monitor ongoing industry and government technology developments and assess the risk and cost-benefit of the technologies to support the requirements of the DoD Components for M&S. The technology shortfalls must be identified and priorities must be developed for DoD investments to exploit technology advances in a timely manner, accelerate technological development, fill technology gaps, and rapidly insert the acquired technology into M&S applications. The Director of Defense Research and Engineering's (DDR&E) Technology Area Plan and M&S Technology Area Review/Assessment are central facets of this activity.

4. Build M&S Capability. A technical framework must be developed to ensure appropriate interoperability across different simulations; reuse of simulation components; insertion of new technologies; and flexibility to respond to changing requirements. Then the DoD Components must employ the necessary technology to build the M&S representations (e.g., entities, applications and systems) and ensure they are populated with certified data. These representations must then be verified, validated, and integrated to provide a useful M&S capability.

5. Field the Capability. The DoD Components must plan the fielding of required M&S applications and systems. The required staffing, communications, data, and management infrastructure must be provided; the M&S software and/or systems must be delivered to the users; and the users must be properly trained in their use, including how to make accreditation² and certification³ decisions. Users will then employ the M&S capabilities to improve readiness, support modernization, and support force structure and sustainment decisions. Configuration Management policies will ensure consistent, compatible M&S usage across the DoD Components.

6. Share the Benefits of M&S. The optimal use of M&S across the Department of Defense will not occur unless the positive (and negative) impacts and cost-effectiveness of M&S are documented and communicated. The DoD Components must educate potential user communities on the existing and expected benefits of M&S employment so that they may make informed investment decisions. This education may include a wide variety of means, such as on-line information systems, seminars, live demonstrations, formal courses of instruction, etc. Where authorized and cost-effective,

² Accreditation is the official certification that a model or simulation is acceptable for use for a specific purpose.

³ Certification is the official approval that M&S data have a specified level of quality or as being appropriate for a specified use, or range of uses.

the Department of Defense must aggressively pursue the exchange of M&S-related requirements, concerns, ideas, and technology among the DoD Components, other Government Agencies, academia, industry, and allied nations.

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